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ABSTRACT

Canadian participation in the Second International Science Study (SISS) has both international and national aims. The international aims are identical with those of SISS and call for a description of science education policy and practice, student achievement testing, and the analysis of students' and teachers' attitudes to science and science teaching. The national aims relate to the diversity of science education in the ten provinces and two territories, each of which constitutes an independent educational authority. This part of the study will compare science curriculum policies with science curriculum practices, will examine the relationship of policy to practice, and will investigate relationships between the mandated and the achieved curriculum. The focus on the policy/practice interface leads to the study of a number of issues, in particular to a study of the nature of policy and of curriculum as presented in official documents, and to a study of teachers' perceptions of the curriculum. (Author)

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A CANADIAN CASE STUDY OF SCIENCE EDUCATION

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THE IEA SECOND INTERNATIONAL
SCIENCE STUDY: CASE STUDIES IN
CANADA, ISRAEL, AND THE U.S.A.

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Goals of the Canadian Study

The Second International Science Study (SISS) has two sets of aims. (1) The first set of aims is international and comparative, relating to the state of science education across the world and to the identification of factors which will explain differences in the outputs of science education among and within countries. The second set of aims, which cooperating countries are encouraged to adopt, relates to issues of national, as opposed to international, interest. Canadian participation in the SISS, made possible by a grant from the SSHRCC, is designed with both sets of aims in view.

The major goals of the international component of the Canadian study are:

1. the analysis of science curricula and the preparation of a national case study describing the processes by which science curricula are developed, implemented and supervised in Canada;
2. participation in the international preparation, trial testing and revision of student achievement tests, student and teacher attitude questionaires, and school background questionnaires;
3. the preparation and finalization of plans for sampling of student and teacher populations throughout Canada and for data analysis;
4. the administration of student achievement tests, student and teacher attitude questionnaires, school background questionnaires, and the analysis of data;
5. the preparation of a national report.

Research procedures carried out in this international-comparative component of the study, will make it possible to describe science education in Canada as a whole, in the context of a world picture created by reports from each of the participating countries. In this process Canada is to be viewed as a single education unit just as are the other countries taking part in the study.

In parallel with this internationally oriented research, and in extension of it, research called for in the investigation of issues of particular interest to Canada will examine the "mosaic" of Canadian education. This will provide a picture of science education in the ten provinces and two territories to be seen and understood in the context of the cross-Canada picture. The study will show the diversity and richness of science education in the provinces and territories, each of which constitutes an independent education authority.

The major goals of the national component of the study, in addition to the international-comparative goals are:

1. to describe science curriculum policy and practices in the provinces and territories;
2. to compare science curriculum policy with science curriculum practice and to examine the relationship of policy to practice;
3. to extend the theoretical formulation and the empirical base of previous research by the principal investigators on the relationship between the mandated and achieved curriculum;

4. to develop national curriculum sampling procedures and a model for national curriculum research which, it is expected, will be of use in other curriculum areas;

5. to establish a solid descriptive basis for further empirical, experimental and ethnographic research in science education in Canada.

Structure of the Study

The Canadian study proceeds from three regional centres situated at Memorial University in Newfoundland, the University of Alberta and the Ontario Institute for Studies in Education. The last named is also the coordinating centre for the study. A research team at each centre is responsible for its regional study and works in cooperation with educators in each of the provinces and territories in the region. (See Figure 1.) This decentralized structure makes it possible to provide for the requirements of both the international study in which Canada is seen as a single education unit, and the national study in which Canada is seen as a federation of independent provincial education units.

The two components of the study, the international and the national, proceed concurrently and are planned in two stages, the first of which is now underway.

In the first stage a national case study will report on the educational system as a whole and will describe science education at the upper primary, lower secondary, and upper secondary levels. The study will relate, in particular, to aims, content, teaching methods, curriculum development, facilities, achievement assessment, teacher training and supervision as called for by the SISS program. The study will be extended in order to provide for specifically Canadian interests such as the nature of the teacher-curriculum interface and the manner in which curriculum policies are translated into curriculum practices and outcomes. The case study will be coordinated with related studies in the field of Canadian science education, especially the ongoing Science Council of Canada project* with a view to providing a descriptive account of Canadian science education and an account of the social context for science and technology education (see Figure 2 for an outline of activities planned for this stage of the study).

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*The aims of this major study are:

1. To establish a documented basis for describing the present purposes and general characteristics of science teaching in Canadian schools.

2. To conduct an historical analysis of science education in Canada.

3. To stimulate active deliberation concerning future options for science education in Canada.

In the second stage of the study SISS testing and background instruments will be administered, data will be analyzed, outcomes forwarded to the SISS international centre in Australia, and a final Canadian report will be prepared.

It is expected that final data analysis will be completed before the close of 1985, and that the national report will be published by July 1986.

Significance of the Canadian Study

The significance of this study derives both from its comparative aspects and its focus on the interface of curriculum policy and classroom teaching practice.

One of the aims of the SISS is to examine the ways in which science education has changed since the early 1970s when the first international science study was carried out (2). Canada was not a member of the first IEA science project and so has no national student achievement data available for comparison. The present study, which will be the first cross-Canada investigation of student achievement in science, will thus constitute a much needed "stock taking" of national and provincial science education, as well as providing an important reference base for future studies. Furthermore, the study comes at a particularly opportune time, since the Science Council of Canada project "Science

Education Study" is now in its final stages. Close liaison has been established between the two projects, in particular with regard to the analysis of curriculum documents, the analysis of science textbooks, a survey of science teachers, and a series of school case studies, which have been carried out in the Science Council study. In addition to providing extremely important background material, these data have given rise to a variety of perspectives and have raised important questions for further research within the framework of the present study.

The study's focus on the policy-practice interface is significant since it will address a number of issues related to the process of science education. Two of these, which we will discuss here are: the nature of policy and of curriculum as presented in official documents; and teachers' perceptions of the curriculum.

Policy and Curriculum

The line of research adopted by the SISS is closely linked to the concepts of intended curriculum, translated curriculum and achieved curriculum. Briefly stated these are what it is intended that the school curriculum should do; the translation of these intentions into educational practice; and the outcomes of education as achieved by students. It is assumed, as a SISS proposition to be examined

internationally, that there is a consistent relationship between these three stages of the curriculum sequence. Furthermore this relationship is seen as being amenable to statistical analysis. The strategy chosen calls for the analysis and numerical rating of intended curriculum content topics, followed by a statistical examination of the relationships among the topic ratings and the outcomes of student achievement testing on these topics.

We see here both a conceptual and a practical difficulty. The former arises from the implied assumption of a direct causal relationship between intended and achieved curricula. The latter arises from the explicit assumption that curriculum content topics can be rated numerically in a meaningful manner (3).

We are attempting to deal with these difficulties by carrying out a qualitative rather than a quantitative analysis of curriculum policy documents. For each province, policy documents are being analyzed so as to describe:

(a) general aims;

(b) organization at the provincial, board and school levels;

(c) policy implementation at the various levels;

(d) the nature of the documents which establish the general format of education; and

(e) curriculum content as mandated or otherwise presented in the guideline documents.

Preliminary work done(4) leads us to believe that from the examination of provincial reports will emerge some useful analytical themes. One possible theme, is the manner in which educational policy as expressed in policy documents, becomes required educational practice as expressed in the more specific curriculum guidelines. For example, an expression of policy on the status of a particular theory in science may be implemented by the mandatory inclusion of given topics in the curriculum. Another possible theme is the relationship between the structure of policy documents and the structure of curriculum content. For example, a particular view of the nature of scientific knowledge embedded in a policy document, may be recognized in the organization of topics included in the curriculum guidelines; or a particular view of scientific investigation as related to other human endeavours may determine the scope and status of science education within the general structure of the curriculum.

We believe that analysis of curricular documents according to appropriately identified themes will provide a reference base for the scrutiny of student outcomes and achievement. This, in our view, will constitute a viable alternative to the proposed IEA statistical analysis, without the need for numerical ratings of curriculum content topics and without the assumption of a simple causal relationship between intentions and outcomes.

Teachers' Perceptions of the Curriculum

In its focus upon the interface of curriculum policy and practice, our study is investigating a phenomenon that is of general educational interest. Teachers' perceptions of a curriculum are of considerable importance in determining the ultimate shape that the curriculum will take, since the curriculum as presented to pupils is an amalgam of mandated guidelines, learning materials, and teacher perceptions. Recent studies by two of the principal investigators, Connelly (5) and Crocker (6) indicate considerable discrepancies between the intentions of curriculum developers and the perceptions and practices of teachers. Such discrepancies are of interest to science educators because they suggest that the careful analysis of the structure and process of science that forms the basis of modern science curricula undergoes considerable modification in the hands of teachers. This is not to argue that curriculum developers merely express idealizations or that teachers are engaged in subversive tactics. Rather, it is hypothesized that the discrepancies reflect fundamental differences in the modes of thinking of the two groups, differences which apparently are not eliminated in science teacher education. An understanding of these discrepancies and of how they arise is, in our view, fundamental to an examination of how science education proceeds at the level of the classroom. We believe that a closer understanding of this problem is therefore an

essential component of research in science education, which will constitute an important Canadian contribution to the international study.

As we have pointed out, this line of research is closely linked to the concepts of intended curriculum, translated curriculum and achieved curriculum which are central to the international study. The SISS program does not, however, deal with teacher perceptions as an intervening factor between the intended and the translated curriculum. The Canadian Study at this point extends the international study and provides greater insight into the process of curriculum translation by investigating teachers' perceptions of curriculum guidelines, textbooks, equipment, curriculum packages and the like which are regarded as essential links in the translation of curriculum policy into practice. Another factor in the process of translation is interpretation. Curriculum documents may be interpreted by different teachers in different ways. Terms and concepts that are clear and unequivocal in the minds of curriculum policy makers may seem vague and ambiguous to teachers. In interpreting curriculum policy and materials for the creation of a manageable classroom environment, the teacher in effect negotiates a compromise. It is the nature of this compromise which determines the character of the translated curriculum, and in turn, that of the achieved curriculum. There are indications that teacher perceptions are also determined, to

a large degree, by the teacher's interaction with pupils, especially by the management concerns that arise in day to day classroom work and by teacher expectations of pupils. For example, Crocker (6) found that teachers' approaches to discovery learning were strongly influenced by a perception that most pupils are incapable of discovery and that much classroom time would be wasted in attempting to teach by means of a discovery mode. He found that this, in turn, influenced teacher interpretations of curriculum guidelines which were being developed by a state education authority.

In keeping with these views we are now developing, as a major task of the first stage of research, a set of research instruments for the investigation of teachers' perceptions of curricular issues and of the process of curricular decision making. These instruments will be administered in the spring of 1983. The analysis of responses, together with the analysis of provincial policy documents and guidelines, and the report of the cross-Canada case study of science education, will constitute the main output of the first stage of the study.

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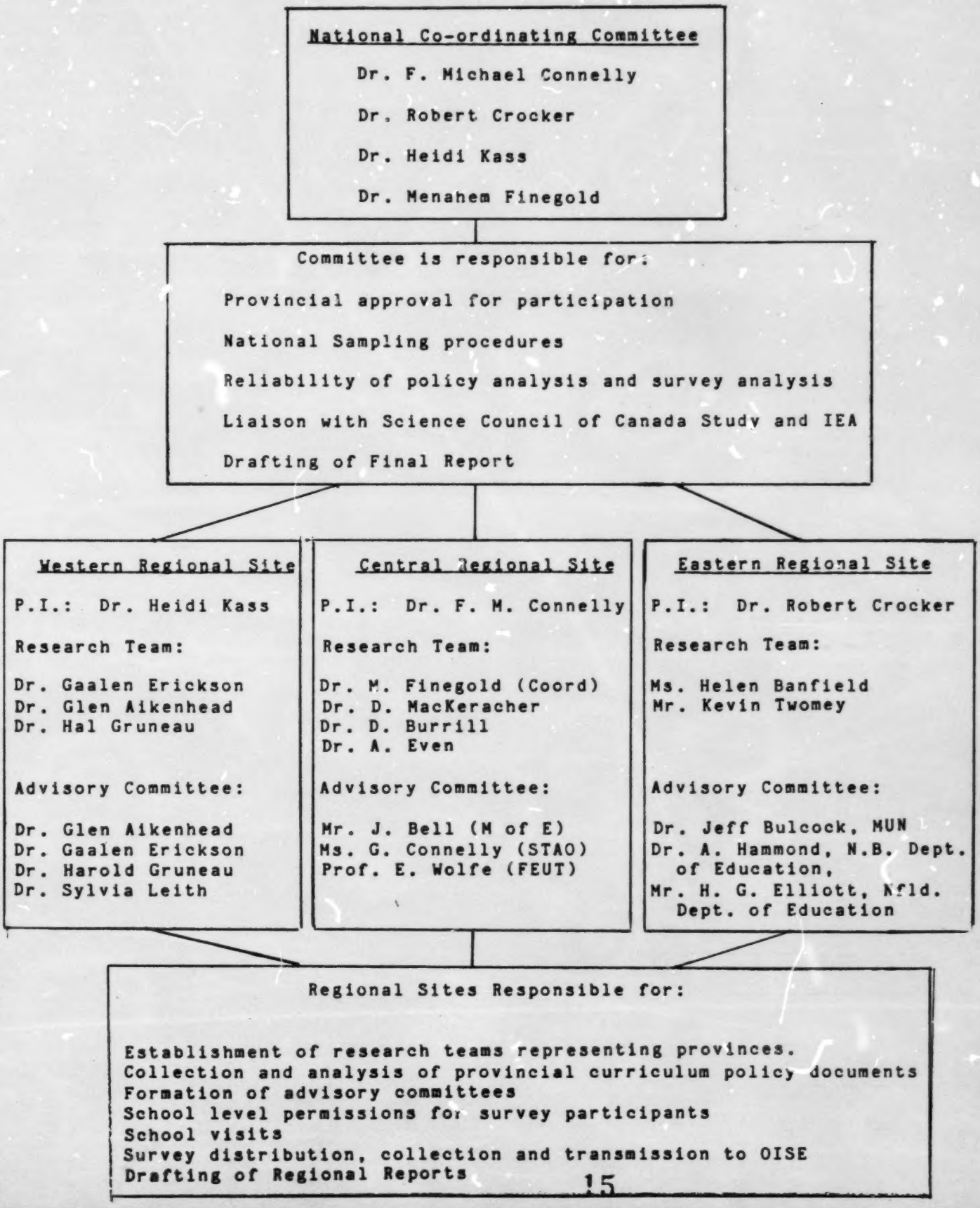
Figures

Figure 1 The Structure of the Canadian Project.

Figure 2 Activities for Stage 1: July 1982 - December 1983.

FIGURE 1: THE STRUCTURE OF THE CANADIAN PROJECT



SCIENCE EDUCATION IN CANADA: POLICY AND PRACTICE

Canadian Involvement in the IEA Second International Science Study (SISS)

Activities for Phase I: July 1982 - December 1983